MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 2, 2016/2017

BMT1024 – ADVANCED MANAGERIAL MATHEMATICS

(All sections / Groups)

1 MARCH 2017
2.30 p.m. - 4.30 p.m.
(2 Hours)

INSTRUCTIONS TO STUDENTS

1. This question paper consists of **NINE (9)** printed pages with 2 sections, excluding the cover page.

2. **Section A – 12 Multiple Choice Questions (24 Marks).**
   Instruction: **Answer ALL the questions**. Shade your answer in the OMR sheet provided.

3. **Section B – 3 Structured Questions (76 Marks).**
   Instruction: **Answer ALL the questions**. Write all your answers in the answer booklet provided. All necessary workings **MUST** be shown.

SECTION A – MULTIPLE CHOICES (24 Marks)

There are 12 questions in this sections. Answer all the questions on the multiple choice answer sheet.

1. Which one is a square matrix?

a) $\begin{bmatrix} 1 & 2 & 4 \\ 2 & 1 & 1 \end{bmatrix}$

b) $\begin{bmatrix} 1 & 2 \\ 0 & 1 \\ 1 & 2 \end{bmatrix}$

c) $\begin{bmatrix} 1 & 2 \\ 4 & 3 \end{bmatrix}$

d) None of the above

2. The symbol $[a_{23}]$ represents

a) 2nd row; 3rd column

b) 3rd row; 2nd column

c) A square matrix

d) None of the above

3. $2\begin{bmatrix} 1 & 0 & -4 \\ 2 & -3 & -1 \end{bmatrix} - \begin{bmatrix} 4 & -2 & 0 \\ 3 & -5 & 1 \end{bmatrix} =$

a) $\begin{bmatrix} 2 & -2 & -8 \\ 1 & -11 & -3 \end{bmatrix}$

b) $\begin{bmatrix} 3 & 2 & -4 \\ -1 & 2 & -2 \end{bmatrix}$

c) $\begin{bmatrix} -2 & 2 & -8 \\ 1 & -1 & -3 \end{bmatrix}$

d) None of the above

4. Given $4\begin{bmatrix} 1 & x \\ -2 & 0 \end{bmatrix} + 2\begin{bmatrix} -2 & 0 \\ y & 0 \end{bmatrix} = \begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}$. Find value x and y.

a) $x=0$ and $y=4$

b) $x=0$ and $y=0$

c) $x=4$ and $y=-5$

d) $x=2$ and $y=1$

Continued...

5. $\begin{bmatrix} 1 & -1 \\ 3 & 4 \end{bmatrix}\begin{bmatrix} 0 & 2 \\ 5 & -3 \end{bmatrix} =$

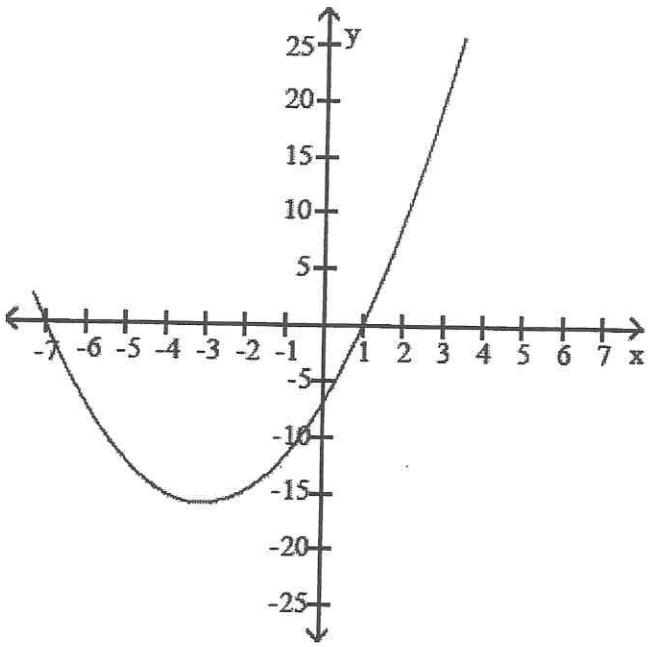
a) $\begin{bmatrix} 0 & -2 \\ 15 & -12 \end{bmatrix}$

b) $\begin{bmatrix} -2 & 8 \\ 3 & 8 \end{bmatrix}$

c) $\begin{bmatrix} -5 & 5 \\ 20 & -6 \end{bmatrix}$

d) $\begin{bmatrix} -1 & 8 \\ 3 & 2 \end{bmatrix}$

6. Describe the graph below correctly according to the given condition of intervals:



a) $f'(x) > 0$ on $[-3,\infty)$, $f'(x) < 0$ on decreasing on $(-\infty,-3]$

b) $f'(x) < 0$ on $(-\infty,\infty)$

c) $f'(x) > 0$ on $(-\infty,-7) \cup [1,\infty)$, $f'(x) < 0$ on $[-7,1]$

d) $f'(x) > 0$ on $[-7,\infty)$, $f'(x) < 0$ on $(-\infty,-7]$

Continued...

7. Determine the intervals for the function $f(x) = x^3 + 18x^2 + 2$ which is decreasing.

a) (-12,0)

b) $(-\infty,-12) \cup (0,\infty)$

c) $(-\infty,-12) \cup (-12,0)$

d) $(0,12) \cup (12,\infty)$

8. What is the critical points for the function $f(x) = (x-2)(x-3)^2$?

a) 2 and 3

b) 2 and $7/3$

c) 3 and $7/3$

d) 3 and $5/2$

9. Given function $f(x) = x^3y^2$, solve for $f_x(2,-1)$:

a) 12

b) -12

c) -1

d) 1

10. Determine the relative extrema point (minimum, maximum or saddle point) for $f(x) = 5x^2 - 6y^2$

a) Maximum point; (0,0)

b) Minimum point; (10,-12)

c) Saddle point; (0,0)

d) Maximum point; (10,-12)

11. Solve the following initial value problem:

$$\frac{dy}{dx} = 9x^2 - 4x + 5 \quad ; y(-1) = 0$$

a) $y = 3x^3 - 2x^2 + 10$

b) $y = 9x^3 - 2x^2 + 5x + 10$

c) $y = 3x^3 - 2x^2 + 5x$

d) $y = 3x^3 - 2x^2 + 5x + 10$

Continued...

12. The demand function for a product is $p = 2200 - q^2$ where p is the price per unit (in RM) for q units. The supply function is $p = 4000 + q^2$. Determine consumers' surplus if the market price is set at RM1300 per product.

a) RM27,333 b) RM8667

c) RM9500 d) RM23,500

SECTION B – STRUCTURED QUESTIONS (76 Marks)

Question 1 (25 Marks)

(a) The economic analysis shows that the consumption expenditures were \$210 billion and \$554 billion in year 2010 and 2014. The disposable income increased from \$230 billion to \$580 in 2010 and 2014.

(i) What does the slope represent?

[2 marks]

(ii) What is the marginal propensity to consume?

[3 marks]

(iii) What is the marginal propensity to save?

[3 marks]

(b) The management of the Win Win company has determined that the demand and supply functions for their products are given by

$$p = 4q^2 - 10q + 6 \quad \text{and} \quad p = 4q^2 - 16q + 18$$

where p is measured in dollars and q is measured in units of a thousand.

Calculate the equilibrium quantity and price.

[6 marks]

(c) Solve the following equation.

$$2^{2x+1} = 8^{x-3}$$

[4 marks]

Continued...

(d) The sales manager of a department store finds that its daily sales begin to fall after the end of a promotional campaign. The sales in ringgit as a function of the number of days after the campaign's end is given by $S = 36000\left(\frac{9}{8}\right)^{-0.1d}$. If he does not want sales to drop below RM30,000 per day, when should he start a new campaign?

[7 marks]

Question 2 (25 Marks)

Solve the linear programming (LP) problem by using the simplex algorithm.

$$\begin{aligned} \text{Maximize} \quad & P = 40x + 30y \\ \text{Subject to} \quad & \\ & x + 2y \le 16 \\ & x + y \le 9 \\ & 3x + 2y \le 24 \\ & x \ge 0, y \ge 0 \end{aligned}$$

[25 marks]

Question 3 (26 Marks)

(a) A manufacturing company sells high quality jackets through a chain of specialty shops. The demand equation for these jackets is given by

$$p = 600 - 2q$$

where p is the selling price (in dollars per jacket) and q is the quantity demanded (in thousands of jackets). The total cost function is given by

$$C(q) = 0.2q^2 + 28q + 200.$$

(i) Generate the profit function, *P(q)* for the sale of those jackets.

[4 marks]

(ii) Determine the number of jackets that must be sold to obtain maximum profit.

[4 marks]

(iii) What is the maximum profit?

[2 marks]

Continued...

(b) It is estimated that the production of weekly output at a particular factory is depends on the number of workers employed. The production output function is given as follows:

$$Q(x,y) = 36x - 3x^2 + 56y - 4y^2$$

where x is the number of skilled workers and y is the number of unskilled workers employed at the factory. Determine the number of workers; skilled and unskilled should be employed in order to maximize the number of weekly output for the factory.

[8 marks]

(c) In a study conducted by Malaysia's Department of Statistics, it was found that the Lorentz curve for the distribution of income for government medical doctors was described by the function

$$f(x) = \frac{13}{14}x^2 + \frac{1}{14}x$$

and the local universities lecturers by the function

$$g(x) = \frac{9}{11}x^4 + \frac{2}{11}x.$$

Compute the coefficient of inequality for each Lorentz curve. Determine which profession has a more equitable income distribution.

[8 marks]

End of Page.

Subject Code : BMT1024
Subject Name: Advanced Managerial Mathematics

LIST OF FORMULAS

1. **Quadratic formula**

$ax^2 + bx + c = 0$ where $a \neq 0$

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

2. **Law of exponents**

(i) $a^0 = 1$

(ii) $a^x \cdot a^y = a^{x+y}$

(iii) $\frac{a^x}{a^y} = a^{x-y}$

(iv) $(a^x)^y = a^{xy}$

(v) $(ab)^x = a^x b^x$

(vi) $\left(\frac{a}{b}\right)^x = \frac{a^x}{b^x}$

3. **Law of Logarithms**

(i) $\log_b b = 1$

(ii) $\log_b 1 = 0$

(iii) $\log_b m^n = n \log_b m$

(iv) $\log_b mn = \log_b m + \log_b n$

(v) $\log_b \left(\frac{m}{n}\right) = \log_b m - \log_b n$

4. **Non-linear functions**

(i) Exponential Growth Model: $Q(t) = Q_0 e^{kt} \quad (0 \leq t < \infty)$

(ii) Exponential Decay Model: $Q(t) = Q_0 e^{-kt} \quad (0 \leq t < \infty)$

(iii) Logistic Growth Model: $Q(t) = \frac{A}{1 + Be^{-kt}} \quad (0 \leq t < \infty)$

(iv) Learning Curves: $Q(t) = C - Ae^{-kt} \quad (0 \leq t < \infty)$

5. **Inverse of a 3 x 3 matrix**

$$A^{-1} = \frac{1}{|A|} adj(A)$$ where Adj(A) = [Cof (A)]^T

6. Cramer's Rule

Given the equations:

$$\begin{cases} ax+by+cz=j \\ dx+ey+fz=k \\ gx+hy+iz=l \end{cases} \rightarrow \begin{bmatrix} a & b & c \\ d & e & f \\ g & h & i \end{bmatrix}\begin{bmatrix} x \\ y \\ z \end{bmatrix}=\begin{bmatrix} j \\ k \\ l \end{bmatrix}$$

$$x=\frac{\begin{vmatrix} j & b & c \\ k & e & f \\ l & h & i \end{vmatrix}}{\begin{vmatrix} a & b & c \\ d & e & f \\ g & h & i \end{vmatrix}}, \quad y=\frac{\begin{vmatrix} a & j & c \\ d & k & f \\ g & l & i \end{vmatrix}}{\begin{vmatrix} a & b & c \\ d & e & f \\ g & h & i \end{vmatrix}}, \quad z=\frac{\begin{vmatrix} a & b & j \\ d & e & k \\ g & h & l \end{vmatrix}}{\begin{vmatrix} a & b & c \\ d & e & f \\ g & h & i \end{vmatrix}}$$

7. Rules of Differentiation

(i) Sum Rule : $\frac{d}{dx}[f(x)\pm g(x)]=\frac{d}{dx}f(x)\pm\frac{d}{dx}g(x)$

(ii) Product Rule : $\frac{d}{dx}[f(x)g(x)]=f(x)\left[\frac{d}{dx}g(x)\right]+g(x)\left[\frac{d}{dx}f(x)\right]$

(iii) Quotient rule : $\frac{d}{dx}\left[\frac{f(x)}{g(x)}\right]=\frac{g(x)\left[\frac{d}{dx}f(x)\right]-f(x)\left[\frac{d}{dx}g(x)\right]}{[g(x)]^2}$

(iv) Derivative of Exponential function: $\frac{d}{dx}\left[e^{f(x)}\right]=e^{f(x)}\left[\frac{d}{dx}f(x)\right]$

(v) Derivative of Logarithmic function: $\frac{d}{dx}[\ln f(x)]=\frac{f'(x)}{f(x)}$

(vi) $\frac{df}{dx}=\frac{df}{dx}+\lambda\frac{dg}{dx}=0$

(vii) $\frac{df}{dy}=\frac{df}{dy}+\lambda\frac{dg}{dy}=0$

(viii) $\frac{df}{d\lambda}=g(x,y)=0$

8. Rules of Integration

(i) $\int(f(x)\pm g(x))\,dx=\int f(x)dx\pm\int g(x)dx$

(ii) $\int e^x dx=e^x+C$

(iii) $\int x^{-1}dx=\int\frac{1}{x}dx=\ln|x|+C$

9. Consumer Surplus

$CS = \int_0^{\bar{x}} D(x)\,dx - \bar{p}\bar{x}$ where $\bar{p}$ is the unit market price, $\bar{x}$ is the quantity sold and D is the demand function.

10. Producer Surplus

$PS = \bar{p}\bar{x} - \int_0^{\bar{x}} S(x)\,dx$ where $\bar{p}$ is the unit market price, $\bar{x}$ is the quantity supplied and S is the supply function.

11. Income Stream

Future value : $A = e^{rT}\int_0^T R(t)e^{-rt}\,dt$

Present value : $PV = \int_0^T R(t)e^{-rt}\,dt$

Where r = interest rate (compounded continuously) and T = terms in years.

12. Annuity

Future value : $A = \frac{mP}{r}\left(e^{rT} - 1\right)$

Present value : $PV = \frac{mP}{r}\left(1 - e^{-rT}\right)$

Where P = size of payment, r = interest rate (compounded continuously), T = terms in years and m = number of payments per year.

13. Gini Index of a Lorentz Curve

$L = 2\int_0^1 [x - f(x)]\,dx$